

GRAPTOLITES FROM TALLONG AND THE SHOALHAVEN GORGE,
NEW SOUTH WALES.

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(Plates i and ii; thirty-three Text-figures.)

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INTRODUCTION.

The village and railway station of Tallong are situated on the Southern Tableland of New South Wales 2,000 feet above sea-level. Into the tableland the Shoalhaven River has cut a gorge 1,500 feet deep. For four-fifths of its length this river flows north, but about four miles south of the village of Tallong it swings to the east, maintaining this direction for about 40 miles until it enters the Pacific Ocean near Nowra. Steeply folded Upper Ordovician slates and quartzites are exposed on the tableland (Woolnough, 1909) as well as in the gorge. Veins in the slate have been mined for tin and copper (Carne, 1911) at the Tolwong mine in the gorge.

While the mine was being worked graptolites were obtained "a little north of Tolwong Extended" (Carne, 1911) and were described by T. S. Hall (1909), first in a paper "On a Collection of Graptolites from Tallong, N.S.W.". Since these graptolites were not obtained from Tallong, in the present meaning of that locality name, some explanation of this title is called for. The syllable "Tal" or "Tol" is in wide use in the district, for example in Tallong, Talwong, Tallawa, Tallawal and Tolwong and is of aboriginal origin. It is variously interpreted as meaning in English either "water" or "tongue of land". The word "Tallong" did not solely signify the immediate neighbourhood of the railway station until 1905, when the name of the railway station, known until then as "Barber's Creek", was changed to Tallong. (Information from Public Relations Office of N.S.W. Railways Department.) It seems probable that the graptolites were collected before this change, because the metalliferous lode at Tolwong in the gorge was discovered in 1904, when the word "Tallong" had not the restricted significance it later acquired. The collection may have been sent to Hall at the Melbourne University with the locality label "Tallong". Hence arose the title of his first paper. A second paper by the same author dealing with a collection from the same locality was published in 1920 (five years after Hall's death). This was called "On a Further Collection of Graptolites from Tolwong", although the specimens described were from the same locality as those dealt with in the 1909 paper. The name "Tolwong" here was perhaps introduced by the Editor, since by 1920 Tallong would be well known as the name of the railway station. However, in the body of this second paper Hall writes of "Tallong". A further complication is introduced, since the specimens Hall described, now in the Mining Museum in Sydney, are labelled as from "Talwong".

A certain amount of confusion has resulted from these various names. It has, for instance, been stated erroneously that graptolites from Ballanya Hill, Tallong (Naylor, 1935) were described by Hall. In neither of Hall's papers were described any graptolites from Tallong, using that word to mean the neighbourhood of the railway line on the Tableland level.

In the present paper graptolites from eight localities on the Tableland level near Tallong are described. Several of these localities lie on the Razorback, which Dr. Woolnough (1909) defines as the long spur extending south between the Shoalhaven River and its tributary, Barber's Creek. Graptolites collected recently at four localities at the river level in the Shoalhaven Gorge are also described.

As far as can be judged from information available about the locality from which the specimens described by Hall (1909, 1920) were obtained, it is not the same as any of the four places in the Gorge from which graptolites described here were collected. Carne (1911) describes it as "a bed of carbonaceous shale a little north of Tolwong Extended". In the same report, Tolwong Extended is said to be on Mining Lease 6. The Geological Survey Office in Sydney supplied the information that Mining Lease 6 was about one mile north of the main mine. Its position is shown on the map with this paper. It is two and a half miles directly south of the nearest locality from which graptolites described in this paper were obtained. That locality is at the mouth of Bungonia Creek and separated from Mining Lease 6 by the tortuous windings of the Shoalhaven River as well as by being on the opposite bank. The graptolites recorded by Hall differ to a certain extent from those obtained from any locality described in this paper. He records forms characteristic of more than one zone.

The site of the Tolwong Mine is now deserted and forgotten. The mine and the remains of the smelting works are on the east side of the Shoalhaven River and the trestles of the "flying fox" which supplied the mine are 1,000 feet above those remains on the opposite or western side of the gorge. The trestles are connected with Bungonia village by a road built when the mine was being exploited, but now fallen into disrepair.

The site of Mining Lease 6, which is extremely difficult of access now, was visited in the course of the present work. The river has to be forded and may be high after rain. The ground rises precipitously from the water's edge. A reasonable area north of the lease was carefully examined but no graptolites were found.

SOURCES OF COLLECTION.

Graptolites have been collected from the following localities (see Text-figure 33).

Locality 1.—Portion 109, Parish of Bumballa, junction Old Bungonia road and the timber track leaving it to the south, 0.8 mile west of the Caoura road. Slates dip 60 degrees E.S.E.

Locality 2.—Ballanya Trigonometrical Station.

Locality 3.—North-west corner of Portion 96, Parish of Bumballa, about 200 yards east of road to Long Point Lookout at point two miles south of railway line. Slates dip S.E. at 50 degrees.

Locality 4.—Eastern edge, Portion 95, Parish of Bumballa near disused mining shafts in dry, hanging tributary to Digger's Creek. (Turn off from Long Point Look-out road 3.1 miles south of railway line.) Slates dip W.N.W. at 65 degrees.

Locality 5.—Public Reserve, Long Point. On narrow track, which, about 30 yards from signpost, leads downhill off the main track from the car park to the Long Point Lookout. Slates dip W.N.W. at 70 degrees.

Locality 6.—On scenic track, west of car park at Long Point overlooking Barber's Creek, about a quarter of a mile west of signpost, about Portion 128, Parish of Bumballa. Slates dip W.N.W. at 60 degrees.

Locality 7.—On track from Long Point to Shoalhaven River, low cutting in slate near junction of tracks, about 400 yards west of shelter shed at Long Point Lookout. Slates dip W.N.W. at 50 degrees.

Locality 8.—On track from Long Point to Shoalhaven River, cuttings in slate between 1,475 and 1,500 feet above sea-level, that is 525 and 500 feet below Lookout.

In the Shoalhaven Gorge graptolites have been collected at the following localities:

Locality 9.—Junction of Barber's Creek and Shoalhaven River, on left bank of creek. Shales dip east at 75 degrees.

Locality 10.—Bank of Shoalhaven River, a quarter of a mile downstream from mouth of Bungonia Creek on left bank of river. In highly dipping micaceous phyllites.

Locality 11.—Bungonia Creek, from its mouth to a quarter of a mile upstream in slates dipping E.S.E. at 60 degrees.

Locality 12.—Two hundred yards upstream from Badgery's Crossing of the Shoalhaven River on left bank of river in quartzite dipping 80 degrees south of west.

NATURE OF ROCKS.

The Marulan igneous intrusion which outcrops to the west of Tallong has metamorphosed the Ordovician slates. The degree of metamorphism affects the ease of splitting the slabs and the condition of the graptolites contained in them. Intense folding has also affected them.

The slates of Locality 4 are the least affected. Slabs down to almost wafer thinness and up to eight inches across can be obtained, though some of the slates are considerably leached. In Localities 2, 6 and 7 incipient chistolite crystals powder the rock and slabs cannot be obtained more than three inches across so that big graptolites are always incomplete. At Localities 3 and 5 the slate is strongly silicified and it is almost impossible to break off anything but cuboidal blocks with sides not plane and not more than one or two inches across. However, comparatively good specimens were obtained from slabs exposed in a small quarry made some years ago at Locality 5.

At Locality 8 intense folding and crumpling has affected the slate as much as has the igneous intrusion. At fossil Localities 9 and 11 in the bottom of the gorge the slates split well. It is remarkable that slates with admirably preserved graptolites are obtained at these localities, but for long stretches elsewhere in the Gorge the slates are completely metamorphosed to phyllites with few or no traces of fossils. However, Messrs. Packham and Veevers were successful in finding graptolites in a phyllite at Locality 10. At Locality 12 the rock is a coarse quartzite. Graptolites are accompanied by phyllocarids at this place.

GRAPTOLITE ZONES REPRESENTED.

The assemblages of graptolites given in Table 1 show some characteristic differences. Locality 11 is characterized by overwhelming numbers of *Climacograptus bicornis* and its former varieties, by *Corynoides* and fragments of *Mastigograptus*. *Orthograptus truncatus* var. *pauperatus*, *Climacograptus minimus*, a very small *Dicellograptus angulatus* and the delicate *Plegmatograptus nebula* are found in Localities 4 and 9. At Localities 4 and 8 *Cl. tubuliferous* and *Cl. caudatus* occur. However, at any one of these localities big diplograptids, often fragmentary, are likely to be found. An Upper Ordovician age is clearly indicated for all these localities.

Miss G. L. Elles, who has been good enough to examine some specimens from Localities 3, 4, 9, 11 and 12, writes: "I think there is no doubt about the horizon. I should refer all of them except those from Badgery's Crossing (Locality 12) to the zone of *Dicranograptus clingani* and near its base."

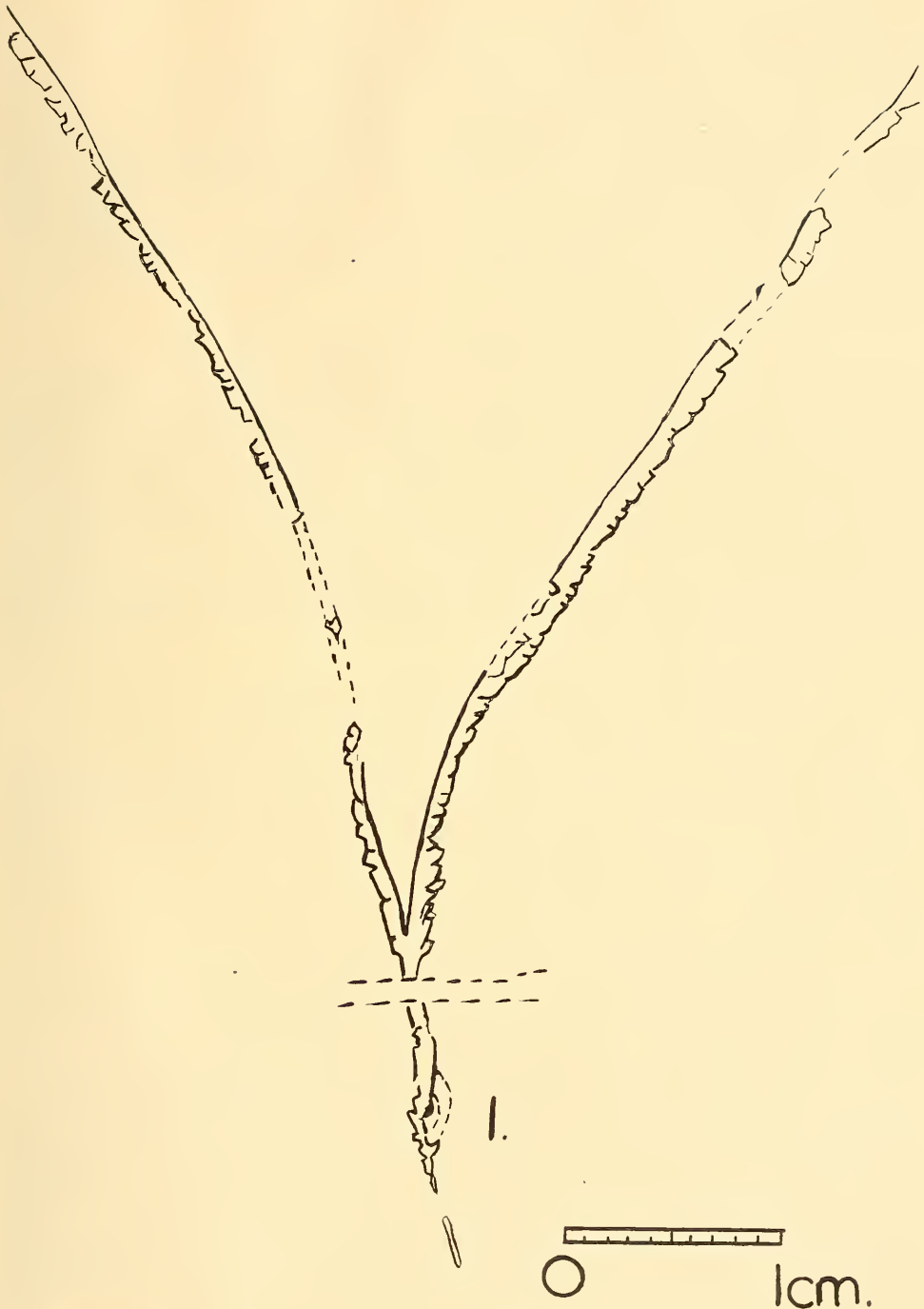
Localities 2, 5, 6, 7 and 8, from which no specimens were sent to Miss Elles, seem to belong to the same zone. It may be that localities 2, 3, 4, 7, 8 and 9 represent a higher section of zone 12 (*Dicranograptus clingani* zone) than Localities 5, 6 and 11.

Locality 1 is indeterminate. Localities 10 and 12 are entirely distinct. At Locality 10 the rock is a phyllite and hence the contained graptolites must have been subjected to considerable pressure. *Dicellograptus* cf. *sextans* and a *Diplograptid*, cf. *Amplexograptus* have been identified. These suggest either zone 9 or 10 of the Upper Ordovician.

Graptolites obtained from Locality 12 at Badgery's Crossing have been identified by Miss Elles, who says they belong to one species only, a new species of *Glyptograptus*, which is described later. Glyptograptidae are not recorded from Zones 12, 13 and 14 of the Upper Ordovician, but are known from zones below and zones above these. Miss Elles, referring to the *Glyptograptus* from Locality 12, has expressed the view: "I can only say that it seems closer to the Silurian types, but it would not be safe to bank on it."

The quartzite at Locality 12, from which this *Glyptograptus* was obtained, occurs on the south-western limb of a steeply folded anticline, which has every appearance of being conformable to the slates containing undoubted Upper Ordovician graptolites. The Silurian rocks found in the south-west of the area have, however, been regarded as unconformable to the Ordovician (Woolnough, 1909).

The implication from present information is, therefore, that Locality 12 belongs to an uppermost Ordovician zone.



Text-figure 1.—*Dicellograptus caduceus* Lapworth. Proximal portion, Loc. 9, No. S.1645.
 (Drawings made of specimens examined through a camera lucida. Where not otherwise stated, specimens are in the collection of the author.)

DESCRIPTIONS OF GRAPTOLITES.

Family DICRANOGRAPTIDAE Lapworth.

Genus DICELLOGRAPTUS Hopkinson.

DICELLOGRAPTUS CADUCEUS Lapworth (Text-fig. 1; Plate i, fig. 1).

Dicellograptus caduceus Lapworth, Elles and Wood, 1904, p. 161.

Stipes 9 cm. long, enclosing an axial angle of 330 degrees and crossing about 1 cm. from proximal end. Stipes slightly less than 1 mm. wide and frequently twisted. Sicula with very long virgella (4 mm.). No lateral spines. Thecae 12 in 10 mm., nearly 2 mm. long with curved ventral margin, aperture introverted and sac-like, overlap one-half. Stipes show graceful double curvature after first crossing but do not cross again.

Associates: *Plegmatograptus nebula*, *Diplograptus truncatus* var. *pauperatus*, *Dicellograptus angulatus*.

DICELLOGRAPTUS cf. SEXTANS Hall (Text-fig. 2, a and b).

cf. *Dicellograptus sextans* Hall, Elles and Wood, 1904, p. 153.

Stipes 4 mm. long and 0.6 mm. wide. Axial angle 300–325 degrees. Axil pointed. Thecae 13–15 in 10 mm. Thecae 1.3–1.5 mm. long, overlap slight, ventral margins curved, apertures sometimes introverted, through pressure, sometimes rolled out into long mucros. Sicula faintly visible in axil. The stipes of some of these very small dicellograptids show what look like thecae on both sides. This appearance is too frequent to be due to two minute diplograptids having come to rest in such a way as to make a similar angle between them. Ruedemann (1908, p. 309) figures a similar braided appearance in his *Dicellograptus sextans* var. *tortus*. *Dicellograptus* cf. *sextans* occurs in the Shoalhaven Gorge only in a phyllite. Hence the graptolites have been subjected to much pressure and the stipes are probably twisted until they are seen in scalariform view.

Associate: cf. *Amplexograptus* sp.

DICELLOGRAPTUS ANGULATUS Elles and Wood (Text-fig. 3, a and b).

Dicellograptus angulatus Elles and Wood, Elles and Wood, 1904, p. 149.

Stipes, greatest length seen 1.3 cm., shortest 3 mm. Generally straight. Diverging at angles 260–340 degrees. Width 0.4–0.8 mm. Axil square, delicate lateral spines. Thecae 11–10 in 10 mm., 1.5 mm. long, overlap one-quarter, sometimes introverted and sometimes everted. Ventral margins slightly curved. Sometimes several of this species occur together, but generally this is not the case.

Associates: *Cryptograptus tricornis*, *Orthograptus truncatus* var. *pauperatus*, *Dicellograptus caduceus*.

DICELLOGRAPTUS cf. FORCHAMMERI Geinitz (Text-fig. 4; Plate i, fig. 2).

cf. *Dicellograptus forchammeri* Geinitz, Elles and Wood, 1904, p. 150.

A very well preserved proximal portion of a *Dicellograptus* from Locality 4 is difficult to place specifically. The axial angle is 305 degrees, the stipes are straight and 2 cm. of each is preserved. The stipes increase in width from 0.6 mm. to just over 1 mm. Th. 1¹ and th. 1² are inclined downward, their ventral margins making an angle of 90 degrees, and are produced in spines 3 mm. long. The virgella is very short. The sicula is a large blunt knob. The second thecae on each side grow upward and not horizontally. Spines are visible on all the proximal thecae and seem to appear just below the aperture, which is said to be characteristic of *D. forchammeri* (Elles and Wood, 1904, p. 137). The thecae are 10 in 10 mm. and seem not more than 1.3 mm. long with scarcely one-third overlap. The curvature of the ventral margins is very slight and the apertures almost everted. The excavation is triangular, occupying one-half the stipe. The lateral spines on this form suggest *D. elegans*, but there is no double curvature of the stipes nor are the ventral margins of the thecae sufficiently curved for this species. The distal portion of the stipes is covered with a mass of stipes of fragments of other graptolites.

Associates: *Dicellograptus angulatus*, *Climacograptus tubuliferus*, *Glossograptus hinksii*.

DICELLOGRAPTUS FORCHAMMERI var. FLEXUOSUS Lapworth (Text-fig. 5, *a* and *b*).

Dicellograptus forchammeri var. *flexuosus* Lapworth, Elles and Wood, 1904, p. 152.

Stipes up to 5 cm. long. Width of stipes 0.4 mm., axial angle 260–305 degrees. Thecae 12–10 in 10 mm., each 1.5–1.0 mm. long, overlap one-third, aperture introverted, excavation pocket-like, occupying half width of stipe proximally, apertural spines seen on many thecae in some specimens. Fine lateral spines, 1 mm. long. Pronounced sicula.

This form suggests a *Leptograptus*, but lateral spines are not found there. The thecae are not of the *Leptograptid* shape and they are more crowded than is the case in that genus.

Associates: *Orthograptus calcaratus* var. *basilicus*, *O. truncatus* var. *pauperatus*, *Climacograptus bicornis*.

Genus DICRANOGRAPTUS Hall.

DICRANOGRAPTUS NICHOLSONI Hopkinson (Text-figs. 6, *a* and *b*; Pl. i, figs. 3, 4).

Dicranograptus nicholsoni Hopkinson, Elles and Wood, 1904, p. 171.

Biserial section 5–7 mm. long, increasing in width from 1 to 2 mm. Spines on 4 proximal thecae on each side. Spines up to 1.3 mm. long. Slender virgella under 1 mm. long. Axial angle 40–60 degrees. Biserial thecae slightly over 1 mm. long with one-fourth overlap. Septum fairly well marked. Uniserial thecae 14–10 in 10 mm., 2 mm. long, overlap about one-half, curved ventral margin with introverted and introverted apertures which practically fill excavations. No spines on uniserial thecae, thus differentiating this form from *Dicranograptus furcatus*. The length of the uniserial stipes varies considerably, it is often only 3 cm. but has been found up to 6 cm. Long stipes curve back towards one another as recorded by Ruedemann (1908) of *D. nicholsoni* var. *diapson*. In one specimen from Locality 12 the uniserial stipes meet at 6 cm. (Text-fig. 6, *a*; Plate i, fig. 3).

Associates: *Climacograptus bicornis*, *C. peltifer*, *Cryptograptus tricornis*.

DICRANOGRAPTUS FURCATUS var. MINIMUS Lapworth (Text-fig. 7).

Dicranograptus furcatus var. *minimus* Lapworth, Elles and Wood, 1904, p. 179.

At Locality 5 the most common fossil is a *Dicranograptus* with biserial portion uniformly 3 mm. long and 0.5–0.7 mm. wide proximally and up to 1.5 mm. wide at the point of bifurcation. There are four thecae on each side of the biserial stipe and half of these have spines up to 1 mm. long. The virgella is never distinct and the presence of a septum is doubtful. The axial angle varies from 35–60 degrees. The uniserial stipes are 1 mm. wide and never more than 2 cm. long and have only a few spines. After diverging at the point of bifurcation, they curve back until they are more or less parallel and resemble *D. nicholsoni* var. *diapson* Gurley, but the biserial portion in that form is longer (up to 6 mm.).

DICRANOGRAPTUS cf. CONTORTUS Ruedemann (Text-figs. 8 and 9; Plate i, fig. 5).

cf. *Dicranograptus contortus* Ruedemann, Ruedemann, 1908, p. 337.

cf. *Dicranograptus contortus* Ruedemann, Ruedemann, 1947, p. 389.

Biserial portion 2–4 mm. long and 1.2–1.8 mm. wide, sometimes with septum well marked. Up to five thecae on each side, each nearly 2 mm. long, overlapping one-third with curved ventral margin. Uniserial stipes diverge at angles up to 100 degrees from sharp V, then either curve strongly concave upward, or one stipe may be concave and the other convex. Uniserial stipes are 0.8–1 mm. wide and 1–3 cm. long. Thecae up to 12 in 10 mm., about 1.5 mm. long, with strongly curved ventral edge, slight overlap and deep excavation. Apertures sometimes introverted. All thecae appear non-spinose.

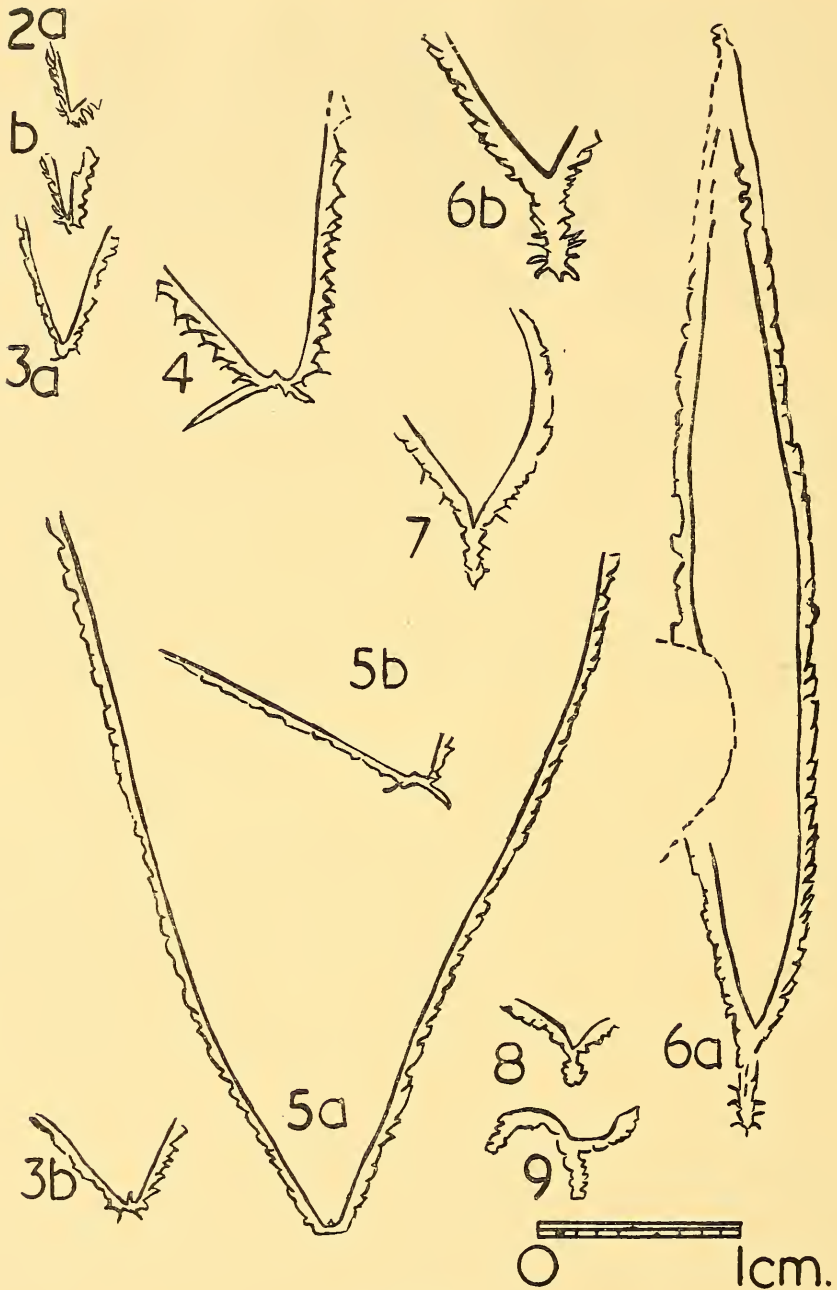
Associate: *Dicranograptus furcatus* var. *minimus*.

Family DIPLOGRAPTIDAE Lapworth.

Genus CLIMACOGRAPTUS Hall.

CLIMACOGRAPTUS BICORNIS (Hall) (Text-fig. 10, *a* and *b*).

Climacograptus bicornis (Hall), Elles and Wood, 1906, p. 193.



Text-figures 2-9.

- 2, a, b. *Dicellograptus* cf. *sextans* Hall, Loc. 10, collected Messrs. G. Packham and J. Veevers.
 3, a. *Dicellograptus angulatus* Elles and Wood, Loc. 5, No. S.1739.
 3, b. *Dicellograptus angulatus* Elles and Wood, Loc. 4, No. S.1771.
 4. *Dicellograptus* cf. *forchammeri* Geinitz, Loc. 4, No. S.1761.
 5, a. *Dicellograptus forchammeri* var. *flexuosus* Lapworth, Loc. 4, No. S.1748.
 5, b. *Dicellograptus forchammeri* var. *flexuosus* Lapworth, Loc. 11, collected by Messrs. Ingall, Joklik and Scott-Orr.
 6, a. *Dicranograptus nicholsoni* Hopkinson, Loc. 11, No. S.1657.
 6, b. *Dicranograptus nicholsoni* Hopkinson, Loc. 11, No. S.1678.

C. bicornis and its former varieties now raised to specific rank, are found in profusion at Loc. 11. The development of the appendages in the former varieties which Ruedemann has studied and figured (1908, p. 80, Plate A) can be paralleled and surpassed at this place, where the length of the virgella in *Cl. tridentatus* and the size of the wings on the shield in *Cl. peltifer* greatly exceed anything shown in Ruedemann's plate.

In *C. bicornis* itself, the rhabdosome is 2.0–2.5 cm. long, 1 mm. wide proximally and 2 mm. wide distally. Thecae 12 in 10 mm., about 1.5 mm. long and overlapping about one-third. Apertural excavations one-quarter width of rhabdosome. The spines on the basal thecae vary from 3 to 6 mm. in length and may be thin downward curving threads or stout structures protruding at an angle of 120 degrees.

Associates: *Climacograptus tridentatus*, *Cl. peltifer*, *Cryptograptus tricornis*.

CLIMACOGRAPTUS PELTIFER (Lapworth) (Text-fig. 11, *a* and *b*; Plate ii, figs. 11 and 12).

Climacograptus bicornis var. *peltifer* Lapworth, Elles and Wood, 1906, p. 195.

Climacograptus peltifer (Lapworth), Elles, 1925, p. 340.

Rhabdosome 5 cm. long. Width proximally is not more than 0.7 mm., widens rapidly to 2.5 mm. in 2 cm. Thecae 11 in 10 mm., about 2 mm. long, overlapping nearly one-half, with small, square apertures occupying no more than one-sixth width of rhabdosome. The basal spines are imbedded in a thick crescent shaped membrane nearly 2 mm. wide normally. The virgella extends beyond the distal end of the rhabdosome. In some specimens the crescent is surrounded and obliterated by an almost circular structure (Text-fig. 11, *b*; Plate ii, fig. 12) measuring at its greatest extent 11 mm. long by 6 mm. wide. The greater length is developed parallel to the length of the rhabdosome. It is not unusual to see a small membrane surrounding the basal spines or bulging from portion of them in this species, but the development now described far exceeds anything previously seen. As mentioned above, it also exceeds anything figured by Ruedemann. *Cl. wilsoni* is characterized by the development of a proximal vesicle of elliptical form. However in that species the greater length is seen at right angles to the length of the rhabdosome. In the specimens from the Shoalhaven Gorge the crescent shape is retained to some extent in the vesicle, and since figure 10c, Plate xxvi, in Elles and Wood (1907) shows a vesicle of the same shape though of a much smaller size, this supports retaining these in *Cl. peltifer*. The virgella seems to protrude from below the membrane in the Shoalhaven specimens.

Associates: as above.

CLIMACOGRAPTUS TRIDENTATUS (Lapworth) (Text-fig. 12, *a* and *b*; Plate ii, fig. 13).

Climacograptus bicornis var. *tridentatus* Lapworth, Elles and Wood, 1906, p. 195.

Climacograptus tridentatus (Lapworth), Decker, 1935, p. 707.

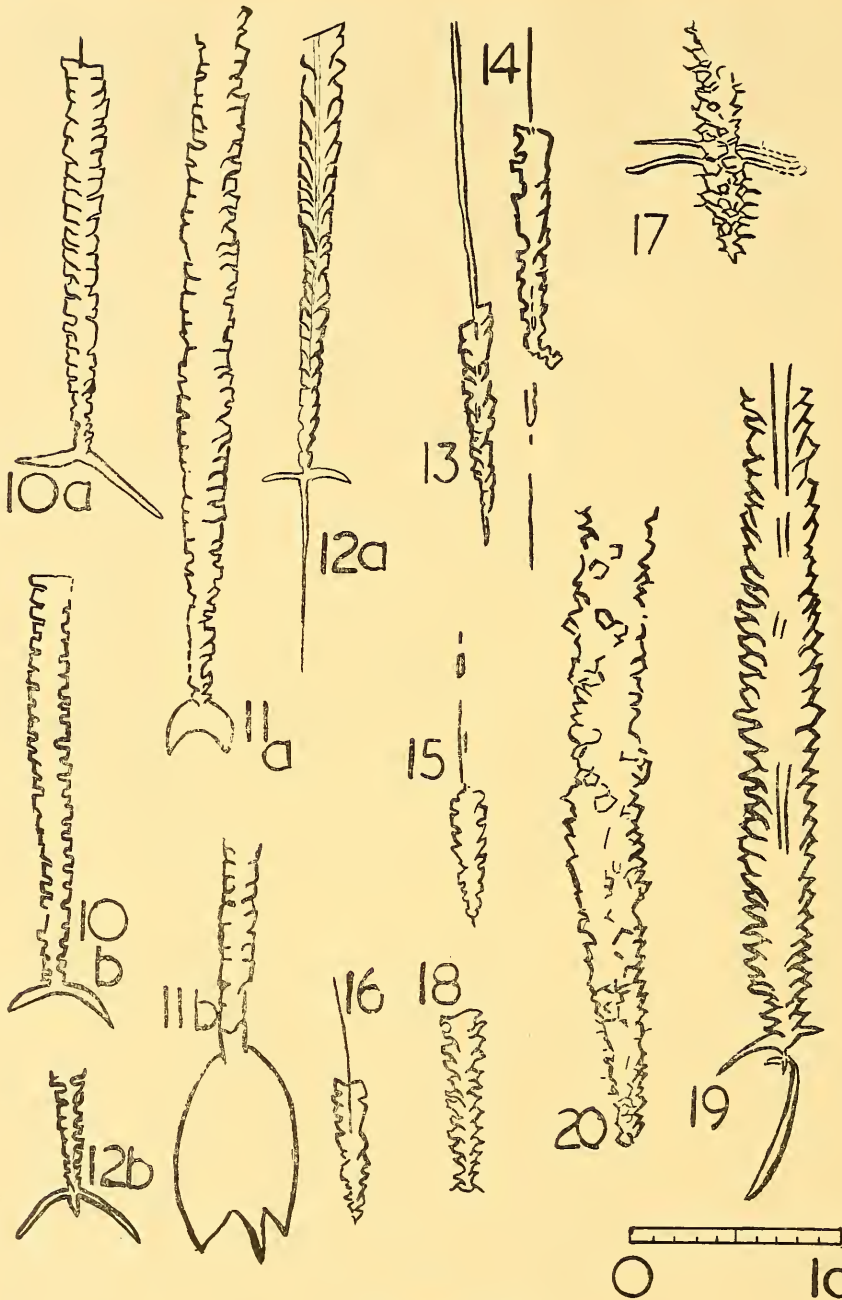
Climacograptus tridentatus (Lapworth), Ruedemann, 1947, p. 439.

Rhabdosome not much more than 3 cm. long preserved, exclusive of the virgella, which may add another centimetre. Width never more than 2.0 mm. There is a prominent virgular tube commencing after the sixth theca and measuring 0.3 mm., where the rhabdosome is broken distally. There are 11 thecae in 10 mm., each measuring 1.5 to 2 mm. long, and overlapping one-third. For half its length the ventral edge of the theca is nearly parallel to the axis of the rhabdosome and then curves down towards the proximal end. The aperture is generally concave upwards, sometimes showing a denticle. The virgella is stout and may be slightly more than 1 cm. long. It is often surrounded by a membrane for half its length. The spines on the basal thecae may be 5 mm. long and make with the virgella an angle of about 90 degrees. T. S. Hall (1902) erected a species, *Climacograptus hastata*, to include forms with a long virgella. The proximal extremity is also reminiscent of *Diplograptus calcaratus*. Miss Elles has kindly examined examples from the Shoalhaven Gorge and identifies them as the species *tridentatus*.

Associates: *Orthograptus apiculatus*, *Climacograptus bicornis*, *Cl. peltifer*.

7. *Dicranograptus furcatus* var. *minimus* Lapworth, Loc. 5, No. S.1719.

8, 9. *Dicranograptus* cf. *contortus* Ruedemann, Loc. 11, collected Messrs. Ingall, Joklik, Scott-Orr.



Text-figures 10-20.

- 10, a. *Climacograptus bicornis* (Hall), Loc. 11, No. S.1683.
 10, b. *Climacograptus bicornis* (Hall), Loc. 11, collected by Messrs. Ingall, Joklik, and Scott-Orr.
 11, a. *Climacograptus peltifer* (Lapworth), Loc. 11, No. S.1676.
 11, b. *Climacograptus peltifer* (Lapworth), Loc. 11, collected by Messrs. Packham and Veevers.
 12, a. *Climacograptus tridentatus* (Lapworth), Loc. 11, No. S.1662.
 12, b. *Climacograptus tridentatus* (Lapworth), Loc. 11, Coll. Messrs. Ingall, Joklik and Scott-Orr.
 13. *Climacograptus tubuliferus* Lapworth, Loc. 4, No. S.1754.
 14. *Climacograptus caudatus* (Lapworth), Loc. 8, No. S.1873.
 15. *Climacograptus minimus* (Carruthers), Loc. 9, No. S.1653.
 16. *Climacograptus brevis* (Elles and Wood), Loc. 11, No. S.1657.

CLIMACOGRAPTUS TUBULIFERUS Lapworth (Text-fig. 13).

Climacograptus tubuliferus Lapworth, Elles and Wood, 1906, p. 203, Pl. xxvii, fig. 8, a-d.

Rhabdosome 2 cm. long and 2 mm. wide attained gradually from 0.5 mm. proximally. Thecae 12 in 10 mm., 2.5 mm. long, free ventral edge slightly inclined. Thecae closely overlap so that excavations not more than one-sixth of width of rhabdosome. Virgella 1 mm. long, virgula 0.2 mm. wide and prolonged 2 cm. beyond rhabdosome and visible in body. The specimens are short and narrow for *Cl. tubuliferus*, suggesting *Cl. minimus*, but the virgula is strongly developed and the number of thecae in 10 mm. agrees with *Cl. tubuliferus*.

Associates: *Dicellograptus angulatus*, *Orthograptus calcaratus* var. *basilicus*.

CLIMACOGRAPTUS MINIMUS (Carruthers) (Text-fig. 15).

Climacograptus minimus (Carruthers), Elles and Wood, 1906, p. 191, Pl. xxvii, fig. 1, a-g.

Rhabdosome 7 mm. long, nearly 2 mm. wide distally, increasing rapidly from width of 0.7 mm. proximally. Thecae alternate, 14 in 10 mm. with slightly curved free edges, overlap slight, perhaps one-quarter. Apertural margin horizontal or everted, opening within triangular excavation one-quarter width of rhabdosome. Virgella 0.7 mm. long, virgula, thread-like, prolonged 1.5 cm.

Associates: *Dicellograptus angulatus*, *Retiolites nebula*.

CLIMACOGRAPTUS CAUDATUS Lapworth (Text-fig. 14).

Climacograptus caudatus Lapworth, Elles and Wood, 1906, p. 202.

Rhabdosome 1-2 cm. long, 2 mm. greatest width, gradually increasing from 0.7 mm. Hair-like virgella prolonged 1.5 cm. surrounded by membrane for about 2 mm. near rhabdosome. Thecae 11 in 10 mm., 1.5 mm. long, overlap one-third, ventral wall slightly sloping, aperture opening within semi-circular excavation, taking up one-sixth of rhabdosome. Virgula prolonged up to 1 cm.

Associates: *Orthograptus calcaratus* var. *basilicus*, *Climacograptus tubuliferus*.

CLIMACOGRAPTUS BREVIS Elles and Wood (Text-fig. 16).

Climacograptus brevis Elles and Wood, Elles and Wood, 1906, p. 192.

Rhabdosome 5 mm. long, gradually increasing in width to maximum of 1 mm. Thread-like virgella prolonged at least 3 mm. Thecae 15 in 10 mm., about 1 mm. long, overlap one-third, with slightly curved ventral edge, short virgella, sicula indistinguishable. The differences between *C. brevis* and *C. minimus* are slight.

Associates: *Lasiograptus harknessi*.

Genus DIPLOGRAPTUS McCoy.

Sub-Genus ORTHOGRAPTUS Lapworth.

DIPLOGRAPTUS (ORTHOGRAPTUS) cf. QUADRIMUCRONATUS var. SPINIGERUS Lapworth (Text-fig. 17).

cf. *Diplograptus* (*Orthograptus*) *quadrimucronatus* var. *spinigerus* Lapw., Elles and Wood, 1907, p. 225.

Spined, biserial graptolite, the best specimen of which is unfortunately broken and the distal end lost. A poorer specimen is not more than 2 cm. long in all. In the best preserved form a length of 1½ cm. can be seen with sicula and proximal thecae in excellent preservation. Thecae are set 12 to 10 in 10 mm. They are 1.5 mm. long and overlap one-half. Width of rhabdosome at sicular end is 0.6 mm. It increases rapidly to 2.5 mm. and this width is retained. All thecae are furnished with apertural spines and there is a short virgella. The apertural spines are rising in a distal direction as they leave the thecae but soon become horizontal. They increase in length from 0.5 mm. on

17. *Diplograptus* cf. *quadrimucronatus* var. *spinigerus* (Lapworth), Loc. 11, coll. Messrs. Ingall, Joklik, Scott-Orr.

18. *Diplograptus truncatus* var. *pauperatus* (Elles and Wood), Loc. 9, No. S.1648.

19. *Diplograptus calcaratus* (Lapworth), Loc. 11, No. S.1662.

20. *Diplograptus calcaratus* var. *basilicus* (Lapworth), Loc. 3, No. S.1826.

the first theca to 1 mm. on the 6th, while the 8th and 9th thecae on each side have spines 6 mm. in length, but spines on succeeding thecae are not more than 1 mm. long. The spines on the 8th and 9th thecae are also broader than the others. The rhabdosome is preserved as a clathria in the form of a hexagonal network with no exochitin remaining between the crossbars. The dimensions are small for *D. (O.) quadrimucronatus* var. *spinigerus* and the associated graptolites belong to a lower horizon than that which it characterizes. Dr. T. S. Hall has described from near Mt. Easton, Victoria (Hall, 1906), a graptolite with four long spines on "about the 7th or 8th thecae" which he referred to *Diplograptus quadrimucronatus*. *D. quadrimucronatus* var. *spinigerus* is also recorded (Thomas and Keble, 1933) from a locality on Emu or Bolinda Creek, Victoria, which was a collecting place of McCoy.

Dr. Ruedemann (1908) excludes all spinose forms from the genus *Diplograptus* because he considers with the development of spinosity changes take place which are of generic value. He points out further "that the spinose forms of '*Diplograptus*' possess as a rule a layer of retiolid meshes . . . and that the development of this layer of meshes and ledges is roughly proportional to that of the spines". He places spinose forms among the Glossograptidae. Elles and Wood (1907) state briefly the resemblance of *O. quadrimucronatus* to the Glossograptidae but leave it among the Diplograptidae.

Dr. Ruedemann quotes *Glossograptus quadrimucronatus* in a discussion on spines, copying a figure of Lapworth's showing a graptolite from Ireland with two long spines on the "fourth or fifth theca". Ruedemann points out that spines in this position cannot have been developed to protect the graptolite but "they express . . . an intrinsic tendency to a repetition of the lateral apertural spines".

O. cf. quadrimucronatus var. *spinigerus* is rare at Loc. 11 but found more commonly, though in very bad preservation, at Loc. 5.

Associates: *Climacograptus peltifer*, *Cryptograptus tricornis*, *Dicranograptus furcatus* var. *minimus*.

DIPLOGRAPTUS (ORTHOGRAPTUS) TRUNCATUS VAR. PAUPERATUS E. & W. (Text-fig. 18).

Diplograptus (Orthograptus) truncatus var. *pauperatus* E. & W., Elles and Wood, 1907, p. 237.

Longest specimens nearly 4 cm., though most about 2 cm. Width 2 mm. Thecae alternate, 13 in 10 mm., up to 2.5 mm. long, overlap one-half. Aperture horizontal to everted. Ventral edge slightly curved. No virgula or virgular tube. The longest of the forms included in this species suggest *O. truncatus* var. *intermedius*, but as 4 cm. is the maximum length, probably all are *O. truncatus* var. *pauperatus*.

Associates: *Dicellograptus caduceus*, *D. angulatus*.

DIPLOGRAPTUS (ORTHOGRAPTUS) CALCARATUS Lapworth (Text-fig. 19; Plate ii, fig. 6).

Diplograptus (Orthograptus) calcaratus Lapw., Elles and Wood, 1907, p. 239.

Rhabdosome often in fragments, which may be 7 cm. long, though incomplete. Complete examples 3 cm. long. Width 2-3 mm. proximally, increasing to 3.5 distally. Thecae 11 in 10 mm., up to 3 mm. long and 0.4 mm. wide. Overlap one-half, inclined 30 degrees. Ventral walls generally convex outwards and apertures are horizontal, everted or concave. Conspicuous virgular tube within rhabdosome throughout its length, 0.6 mm. wide. Virgula continued more than 5 mm. beyond rhabdosome. Proximally shows well-developed basal spines, 2-3 mm. long and virgella up to 8 mm. Virgella sometimes appears distorted and split but this may be due to the covering membrane breaking away.

Associates: *Climacograptus tridentatus*, *Orthograptus apiculatus*.

DIPLOGRAPTUS (ORTHOGRAPTUS) CALCARATUS VAR. BASILICUS Lapworth (Text-fig. 20).

Diplograptus (Orthograptus) calcaratus var. *basilicus* Lapworth, Elles and Wood, 1907, p. 243.

Rhabdosome over 4 cm. long, 2.5 mm. wide, with short basal spines and virgella. Thecae 11 in 10 mm. Thecae 2 mm. long, overlap one-half or more. A suggestion of spines on some thecae. Central virgular tube not always distinct.

Associates: *Dicellograptus angulatus*, *D. forchammeri* var. *flexuosus*, *Climacograptus tubuliferus*, *Cl. minimus*.

DIPLOGRAPTUS (ORTHOGRAPTUS) APICULATUS (E. & W.) (Text-fig. 21, *a, b, c*; Plate ii, fig. 7).

Diplograptus (Orthograptus) rugosus var. *apiculatus* E. & W., Elles and Wood, 1907, p. 245.

Diplograptus (Orthograptus) apiculatus (Elles & Wood) Bulman, 1946, p. 51.

The rhabdosome is generally short, less than 2 cm. long, though broken fragments of more than 4 cm. have been obtained. Its greatest width is slightly more than 3 mm., and is attained rapidly from an initial width of 1 mm. It narrows slightly distally. The thecae number 11 in 10 mm. and are 2 mm. long overlapping one-half. The apertural margin is usually everted and produced into a denticle. A short spine, 0.5 mm. long, appears on the two basal thecae. A short, stout virgella is about the same length usually. Excavations are pronounced. The thread-like virgula may be produced for at least 2 cm. beyond the rhabdosome.

Associates: *Climacograptus tridentatus*, *Orthograptus calcaratus*.

Sub-Genus GLYPTOGRAPTUS Lapworth.

DIPLOGRAPTUS (GLYPTOGRAPTUS) ROSTRATUS sp. nov. (Text-fig. 22, *a, b*; Plate ii, figs. 9, 10).

Rhabdosome 4 cm. long, width proximally 1.5 mm., widening gradually to 3 mm. Stout blunt sicula with no virgella preserved. Short curving basal spines. Thecae alternate, 12-10 in 10 mm. Each theca about 2 mm. long and overlapping one-third to one-quarter. Excavations wide and triangular. Ventral margins of thecae first convex then concave. Apertural margin convex, produced to a denticle which forms a beak when it meets the ventral edge, hence the specific name. Septal groove well marked. Thecal margins strongly marked. Indistinct virgula. Specimens preserved in relief. Moulds of thecae seen as comparatively deep pockets which deepen towards the apertural denticle.

This species is found in one locality only, that is Locality 12, close to Badgery's Crossing of the Shoalhaven River (Joplin, 1945). Graptolites and phyllocarid carapaces are preserved in black in low relief in a dark-grey coarse-grained quartzite. There is a noticeable parallelism in the arrangement of the rhabdosomes. The majority are not preserved in the bi-profile aspect but are seen in three-quarter face, half face and quarter face. In some cases they almost look mono-serial. On one slab of 17 graptolite fragments, only one when examined in the field with a hand lens appeared to show thecae on both sides.

Miss G. L. Elles was good enough to examine some of these specimens which were sent to her at the Sedgwick Museum, Cambridge, and she has stated:

"The specimens from Badgery's Crossing are, I think, all different views of the same graptolite which is certainly a *Glyptograptus*, but seems to be a new form, or rather one unknown to me. The thecae are of the advanced type of *Glyptograptus* and recall *G. serratus* but it is *not serratus*. All the Glyptograptids I know from early Ordovician rocks have a simpler type of cell. I can only say that it seems *closer* to the Silurian types but it would not be safe to bank on it. You have it in all sorts of aspects, half face, quarter face, three-quarter face and scalariform views and those in (or nearly) profile view are not quite like any known to me."

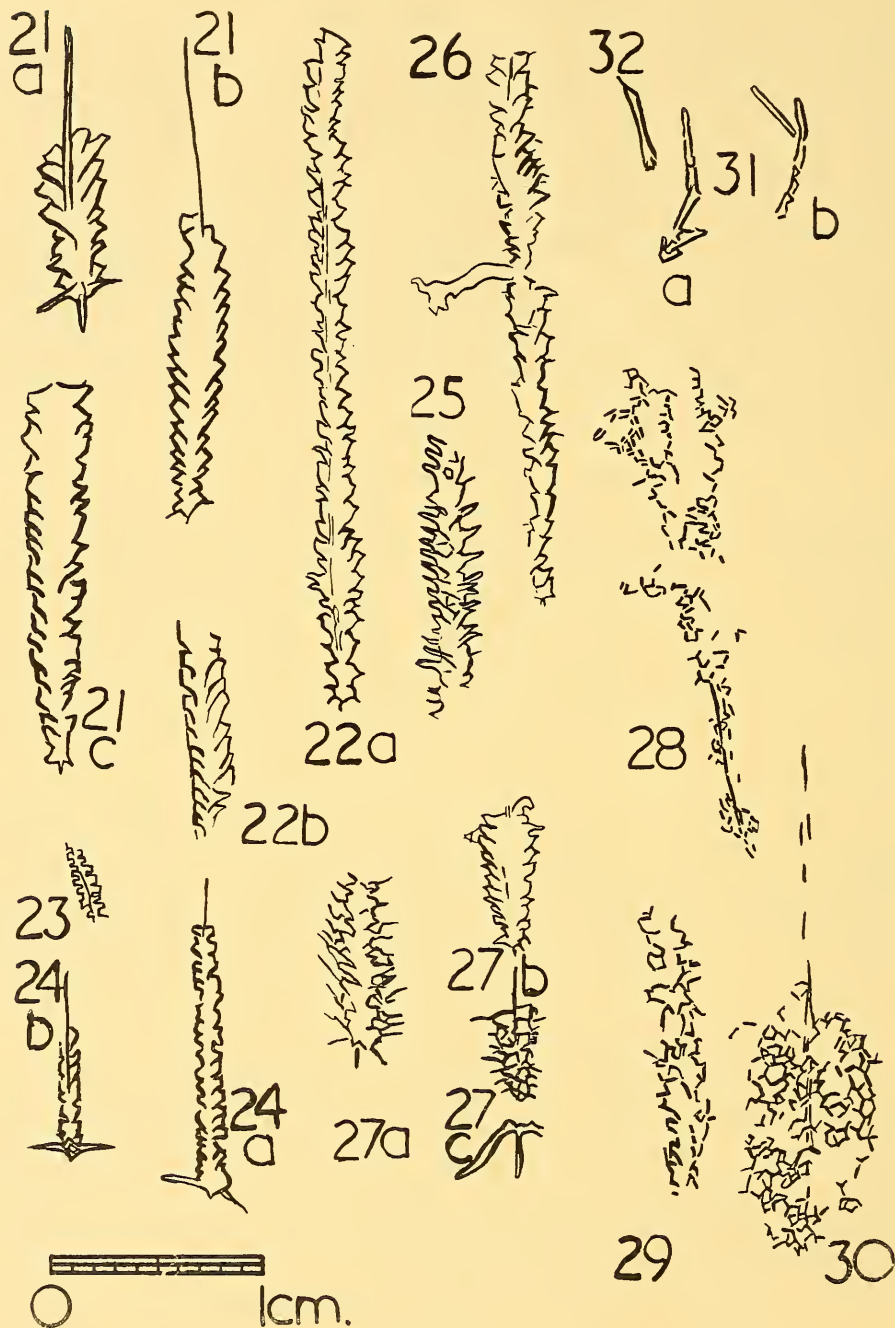
Sub-Genus "MESOGRAPTUS" Elles and Wood (Bulman, 1929).

Group II. AMPLEXOGRAPTUS.

cf. DIPLOGRAPTUS (AMPLEXOGRAPTUS) sp. indet. (Text-fig. 23).

Fragments up to 3 mm. long and 1 mm. wide. Well-marked septum, slightly undulating. Thecae 16 in 10 mm., alternate, 1 mm. long, overlap one-third, with vertical ventral edge and horizontal aperture. Excavation strongly marked, taking up one-third width of rhabdosome.

Associate: *Dicellograptus* cf. *sertans*.



Text-figures 21-32.

- 21, a. *Diplograptus apiculatus* (Elles and Wood), Loc. 11, No. S.1662.
 21, b. *Diplograptus apiculatus* (E. & W.), Loc. 11, coll. by Messrs. Ingall, Joklik, Scott-Orr.
 21, c. *Diplograptus apiculatus* (E. & W.), Loc. 4, No. S.1762.
 22, a. *Glyptograptus rostratus* sp. nov., Loc. 12, No. S.1926.
 22, b. *Glyptograptus rostratus* sp. nov., Loc. 12, Sydney University Geological Department Collection, Reg. No. 8289.
 23, cf. *Amplexograptus*, sp. indet., Loc. 10, coll. Messrs. Packham and Veevers.
 24, a. *Cryptograptus tricornis* (Carruthers), Loc. 11, No. S.1683.

Family CRYPTOGRAPTIDAE Hadding, restr. Bulman.

Genus CRYPTOGRAPTUS Lapworth.

CRYPTOGRAPTUS TRICORNIS (Carruthers). (Text-fig. 24, *a* and *b*.)

Cryptograptus tricornis (Carruthers), Elles and Wood, 1908, p. 296.

Rhabdosome 0.5 mm. to 2 cm. long and slightly more than 1 mm. wide, sometimes wider proximally than distally. Thecae 12 in 10 mm., of *Climacograptus* type and 1.5 mm. long, overlapping for one-half their extent. Apertures sometimes inclined and sometimes semicircular when they occupy one-fourth width of rhabdosome. Basal spines very conspicuous up to 2 mm. long, may be drooping or stiff and at right angles to direction of rhabdosome. Sicular spine wide and noticeable, up to 0.5 mm. long. Faint thread-like virgula prolonged beyond rhabdosome for 2 mm. and visible through test of rhabdosome from about third theca. Sicular ring bearing four spines very noticeable in some specimens. (See Text-fig. 24, *b*.) As Ruedemann points out, the specific name is a misnomer.

Associates: *Climacograptus bicornis*, *C. pettifer*, *C. tridentatus*.

Family GLOSSOGRAPTIDAE Lapworth.

Genus GLOSSOGRAPTUS Emmons.

GLOSSOGRAPTUS HINCKSII (Hopkinson). (Text-fig. 25; Plate ii, fig. 8.)

Glossograptus hincksii (Hopkinson), Elles and Wood, 1908, p. 309.

Well-preserved specimens of this graptolite are incomplete. Rhabdosome 2 cm. long but broken at both ends. It maintains a uniform width of 1.8 cm. Thecae of diplograptid form and about 8 in 10 mm. Some thecae with aperture pressed into a denticle only, but usually prolonged to a spine of 1 mm. length. Septal spines are very conspicuous, and are stout and stiff and 1 mm. long. The impression is clearly that of a form with a rounded or hexagonal cross-section. This is shown because of the grouping of the spines which are more closely preserved in some places than others, on account of the chance as to which side the spines behind the rhabdosome have been bent over and preserved. For this reason the number of thecae per millimetre is difficult to determine. The best preserved impressions are sub-scalariform and therefore the width is not as great as in a bi-profile view. Septal threads are occasionally seen.

Associate: *Cryptograptus tricornis*.

Genus LASIOGRAPTUS Lapworth *s. str.*LASIOGRAPTUS HARKNESSI (Nicholson). (Text-fig. 27 *a*, *b*, *c*; Plate ii, fig. 14.)

Lasiograptus (Thysanograptus) harknessi (Nicholson), Elles and Wood, 1908, p. 325.

Lasiograptus harknessi (Nicholson), Bulman, 1947, p. 71.

Rhabdosome up to 8 mm. long and 2 mm. wide, exclusive of spines. Width at proximal end 0.5 mm. Three spines, possibly paired, seen at proximal end in some specimens. In one example, what appear to be a pair of basal spines 4 mm. long and a virgella (2.5 mm.) are preserved immediately below the rhabdosome, but with no connecting test retained (see Text-fig. 27, *c*). Thecae 15-16 in 10 mm., from 1-2 mm. long, overlapping one-half. They are diplograptid in shape with everted apertures. Apertural spines up to 1 mm. long on all thecae which anastomose to form the marginal network, which, however, is never entirely complete. The size of the rhabdosome allies this with *L. harknessi*, though the number of thecae per millimetre, which can be measured quite exactly in some cases, are those found in the variety *costatus*.

Associates: *Orthograptus calcaratus*, *Corynoides calicularis*.

24, *b*. *Cryptograptus tricornis* (Carruthers), Loc. 11, No. S.1659.

25. *Glossograptus hincksii* (Hopkinson), Loc. 11, coll. Messrs. Ingall, Joklik, Scott-Orr.

26. *Lasiograptus cf. mucronatus* (Hall), Loc. 7, No. S.1895.

27, *a*. *Lasiograptus harknessi* (Nicholson), Loc. 11, coll. Messrs. Ingall, Joklik, Scott-Orr.

27, *b*. *Lasiograptus harknessi* (Nich), Loc. 8, No. S.1857.

27, *c*. *Lasiograptus harknessi* (Nich), Loc. 8, No. S.1865.

28. *cf. Neurograptus margaritatus* (Lapworth), Loc. 2, No. S.1777.

29. *Neurograptus cf. fibratus* (Lapworth), Loc. 8, No. S.1862.

30. *Plegmatograptus nebula* Elles and Wood, Loc. 9, No. S.1645.

31, *a* and *b*. *cf. Mastigograptus*, sp. indet., Loc. 11, No. S.1667.

32. *Corynoides calicularis* Nicholson, Loc. 11, No. S.1670.

Sub-Genus HALLOGRAPTUS Carruthers MS.

LASIOGRAPTUS cf. (HALLOGRAPTUS) MUCRONATUS (Hall). (Text-fig. 26.)

cf. *Lasiograptus (Hallograptus) mucronatus* (Hall), Elles and Wood, 1908, p. 321.

Rhabdosome 2.5 cm. long and 2 mm. wide, limp and lax. Thecae 12 in 10 mm., 2 mm. long, overlapping half, mesial spines usually preserved on ventral edge. Virgella short. What appears to be a scopulate process is shown on one theca. It is 4 mm. long and 0.8 mm. wide and has a two-pronged end.

Associates: *Climacograptus bicornis*, *Lasiograptus harknessi*.

Sub-Genus NEUROGRAPTUS Lapworth.

LASIOGRAPTUS (NEUROGRAPTUS) cf. FIBRATUS (Lapworth). (Text-fig. 29.)

cf. *Lasiograptus (Neurograptus) fibratus* (Lapworth), Elles and Wood, 1908, p. 331.

Incomplete rhabdosomes, 2½ cm. long and 2½ mm. wide. Test attenuated, especially distally. Clathria strongly outlined. Thecae 11 in 10 mm., *Diplograptus*-like, apertural margins of adjoining thecae connected by vertical threads. Short spines on the outside of these.

Associates: *Climacograptus tubuliferous*, *Lasiograptus harknessi*.

cf. LASIOGRAPTUS (NEUROGRAPTUS) MARGARITATUS (Lapworth). (Text-fig. 28.)

cf. *Lasiograptus (Neurograptus) margaritatus* (Lapworth), Elles and Wood, 1908, p. 332.

Limp, lax rhabdosome, 2 cm. long, and 1.5 mm. wide. Thecae 15 in 10 mm., of *Lasiograptus* type, 2 mm. long, overlap nearly one-half. Lacinia incomplete, but spines visible.

Associates: *Diplograptus* cf. *calcaratus*, *Climacograptus minimus*.

Family RETIOLITIDAE Lapworth (restricted).

Sub-Genus PLEGMATOGRAPTUS Elles and Wood.

RETIOLITES (PLEGMATOGRAPTUS) NEBULA Elles and Wood. (Text-fig. 30.)

Retiolites (Plegmatograptus) nebula Elles and Wood, Elles and Wood, 1908, p. 340.

This form is preserved as a delicately traced silvery network, without a continuous membranous test. The rhabdosome consists of a clathria of horizontal threads joined together by vertical strands of which the obverse and reverse members are almost superimposed by compression. Attached to notches on the threads of the clathria is the reticula, made up of 5- or 6-sided meshes the sides of which are about 0.2 mm. long and exceedingly fine, distinctly finer than the bars of the clathria. In some cases a network representing a lacinia is fairly complete. The meshes of the lacinia are slightly larger than those of the reticula. The largest form is 11 mm. long and 5 mm. wide. In the absence of a continuous test the shape of the thecae is difficult to dissociate from the reticula. Apparently there are 13 thecae in 10 mm., each theca being about 1 mm. long and overlapping one-third. The ventral wall is strongly inclined. The virgella is prolonged 1½ cm. beyond the rhabdosome and a short virgella (0.5 mm.) can be seen.

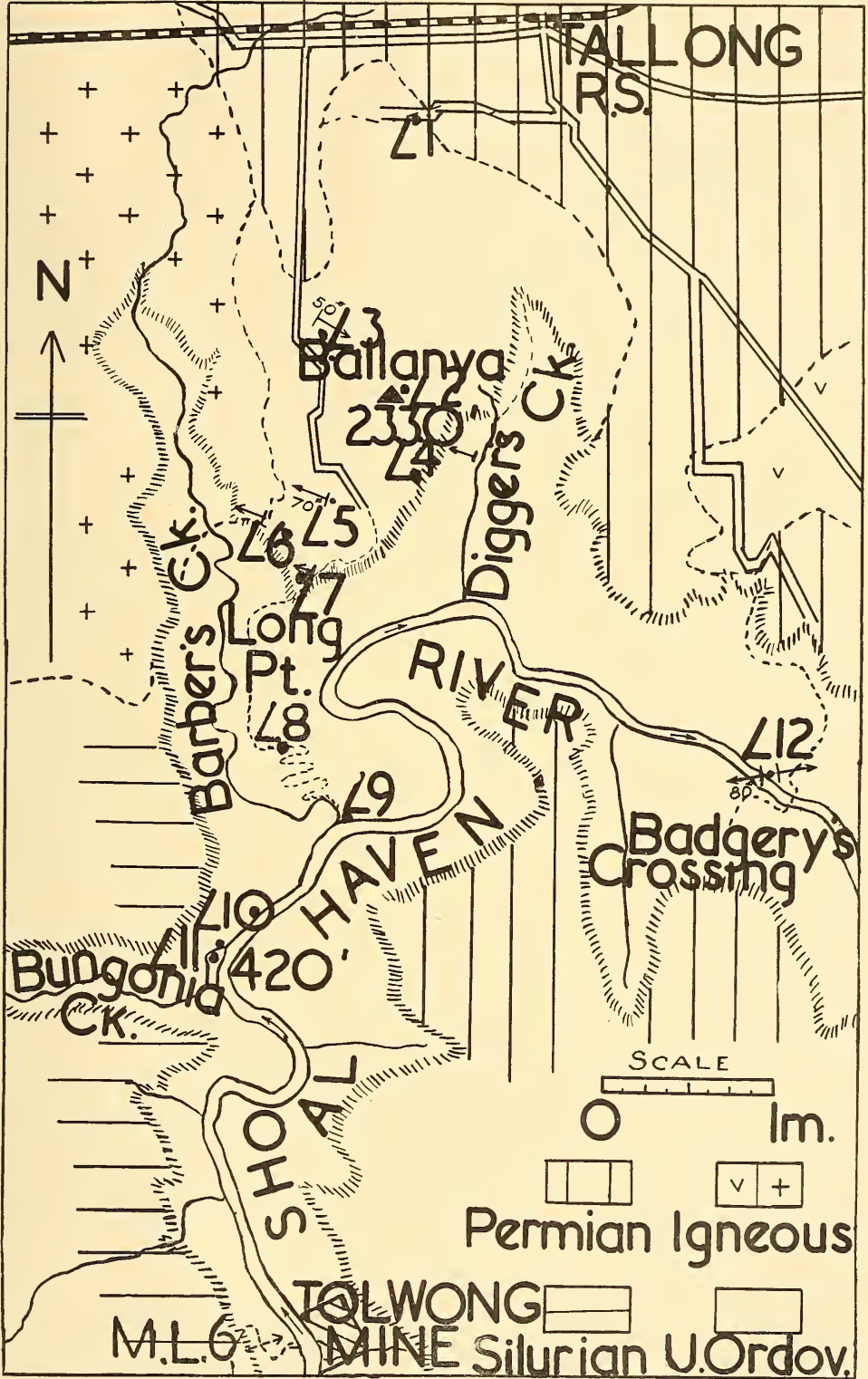
Retiolites (P.) nebula is the only recorded Upper Ordovician *Retiolites*. Dr. T. S. Hall found *Retiolites* to be very common in the New South Wales Geological Survey Collection from Stockyard Flat Creek, County of Wellesley, which he described (1902), and he erected a new species, *Retiolites caudatus*, with a conspicuous nema and virgula. Specimens of the species were 22 mm. long and 6 mm. wide. However, Miss G. L. Elles, in the correlation table which she drew up for Sir Edgeworth David's Explanatory Notes (1932), indicates that *Ret. caudatus* T. S. Hall is equivalent to *Plegma nebula* E. & W. The diagnosis of the form records a maximum width of 2 mm., but it is noted that "a larger and wider form is referred to this species. (It) may eventually be separated off as a distinct variety".

Order DENDROIDEA Nicholson.

Family DENDROGRAPTIDAE Roemer.

Genus MASTIGOGRAPTUS Ruedemann. (Text-fig. 31, a, b.)

cf. *Mastigograptus* sp. indet. Ruedemann, 1908, p. 210.



Text-figure 33.—Geological Sketch Map of the Tallong and Shoalhaven Gorge Districts. Geological boundaries after Woolnough, Craft and Regional Map issued by Premier's Department, N.S.W.

At Locality 11 a large number of minute graptolite-like forms are found on some slabs of slate. They lie crowded in a random arrangement about 30 to the square inch. They can be divided into two types. One type consists of a tangled mass of short, straight or slightly curved forms, sometimes branched, all incomplete. None is longer than 1.5 cm., nor wider than 0.3 mm. They lie massed on top of one another at all angles. Since there are no specimens with wide stipes such as Ruedemann (1908) describes in *Thamnograptus* where the main stipe by secondary thickening is found up to 1.5 mm. wide, these fossils seem best compared to *Mastigograptus* sp. indet. Only one branch is seen in any one specimen, and no triangular appendages are found attached to stipes or branches as described by Ruedemann (1908), p. 212. However, he states that these must have been easily detached and loose fragments on the slabs from Locality 11 may represent them. Ruedemann records *Mastigograptus* from the Trenton and Utica horizons, which are equivalent to Zones 9-12 of the British succession of the Upper Ordovician. In Victoria, *Mastigograptus* has been recorded from the Cambrian. (Chapman and Thomas, 1936.)

Family CORYNOIDIDAE Bulman.

Genus CORYNOIDES Nicholson.

CORYNOIDES CALICULARIS Nicholson. (Text-fig. 32.)

Corynoides calicularis Nicholson, Ruedemann, 1908, p. 234.

Corynoides cf. *calicularis* Nicholson, Bulman, 1945, p. 27.

The second type of graptolite-like form from Locality 11 is smaller than cf. *Mastigograptus*, not being more than 5 mm. long (excluding nema) and slightly less than 0.5 mm. wide. This has been identified as *Corynoides calicularis* Nicholson. The rhabdosome is suspended from a very slender nema (2 mm. long) which sometimes, however, is not preserved. At the base of the rhabdosome can be detected the aperture of the sicula, with that of a theca on each side of it.

The structure of *Corynoides* has been recently considerably elucidated by Bulman (1945-47) from material preserved in limestone, which could be dissolved away leaving *Corynoides* which could then be examined under a microscope. Bulman found that the sicula extends the full length of the rhabdosome from the slender nema to the base where is the aperture of the sicula with the virgella projecting. Its aperture is seen as a concave structure at the base of the specimen. Thecae up to three in number bud off in turn from alternate sides of the sicula and near its apical end and grow down along the sicula until their apertures, too, open on either side of the sicular aperture. As well as the virgella of the sicula, each theca has a virgella also, which projects beyond the base, making an angle with the sicular virgella. These were taken previously for spines. These features can be recognized in *Corynoides calicularis* from the Shoalhaven Gorge, where it is, however, preserved as thin, chitinous films on slate.

The systematic position of *Corynoides* has been a question of debate and even now Bulman says (1945, p. 23), "I am leaving it provisionally as a distinct family of the Graptoloidea", which suggests he foresees later revision.

Corynoides has apparently not been recorded from any other locality in Australia, until identified from the Shoalhaven Gorge (Sherrard, 1947). It occurs fairly commonly in North America and Europe. The fact that it had not been identified from South America caused Bulman to comment in 1931 "the absence of *Corynoides* is remarkable, as this constitutes such an important member of the Canajoharie fauna and of that of the *Dicranograptus clingani* Zone of Northern Europe". Its discovery in Australia provides further evidence, if any were needed, of the similarity of graptolite faunas of the same age throughout the world.

SUMMARY.

Upper Ordovician graptolites from Tallong and the Shoalhaven Gorge are described and figured, one of them a new species. *Corynoides calicularis*, characteristic of North European and North American graptolite-bearing beds, is recorded from Australia for the first time.

TABLE I.
Graptolites Collected from Various Localities at Tallong and the Shoalhaven Gorge.

	Recorded from.							
	Extra-Australian Localities.					Australian.		
	Zone 9. <i>Nema.</i> <i>gracilis.</i>	Zone 10. <i>Cl.</i> <i>peltifer.</i>	Zone 11. <i>Cl.</i> <i>wilsoni.</i>	Zone 12. <i>Dier.</i> <i>clingani.</i>	Zone 13. <i>Pl.</i> <i>linearis.</i>	Gis- bornian.	East- onian.	Bolin- dian.
LOCALITY 1 contains: Indeterminate graptolite fragments.								
LOCALITY 2 contains: <i>Climacograptus</i> sp. indet. <i>Cl.</i> cf. <i>minimus</i> (Carr.) <i>Diplograptus</i> (<i>Orthograptus</i>) cf. <i>calcaratus</i> Lapworth Cf. <i>Lasiograptus</i> (<i>Neurograptus</i>) <i>margaritatus</i> (Lapworth)				X	X		X	X
LOCALITY 3 contains: <i>Dicellograptus forchammeri</i> var. <i>flexuosus</i> Lapw. <i>Dicranograptus furcatus</i> var. <i>minimus</i> Lapworth <i>D. nicholsoni</i> Hopk. <i>Climacograptus bicornis</i> (Hall) <i>Diplograptus</i> (<i>Orthograptus</i>) <i>cal-</i> <i>caratus</i> var. <i>basilicus</i> Lapw. <i>Cryptograptus tricornis</i> (Carr.) <i>Retiolites</i> (<i>Plegmatograptus</i>) <i>nebula</i> E. and W.		X	X	X	X	X	X	X
LOCALITY 4 contains: <i>Dicellograptus</i> cf. <i>forchammeri</i> Geinitz <i>D. forchammeri</i> var. <i>flexuosus</i> Lapworth <i>D. angulatus</i> E. and W. <i>Climacograptus tubuliferus</i> Lap- worth <i>Cl. bicornis</i> (Hall) <i>Cl. minimus</i> (Carruthers) <i>Diplograptus</i> (<i>Orthograptus</i>) <i>trun-</i> <i>catus</i> var. <i>pauperatus</i> E. and W. <i>D. (O.) calcaratus</i> var. <i>basilicus</i> Lapw. <i>D. (O.) apiculatus</i> (E. and W.) <i>Glossograptus hincksii</i> (Hopk.) <i>Retiolites</i> (<i>Plegmatograptus</i>) <i>nebula</i> E. and W.	X	X	X	X	X		X	X
LOCALITY 5 contains: <i>Dicellograptus angulatus</i> Elles and Wood <i>Dicranograptus nicholsoni</i> Hopk. <i>D. furcatus</i> var. <i>minimus</i> Lapworth <i>D.</i> cf. <i>contortus</i> Ruedemann <i>Climacograptus</i> sp. indet. <i>Diplograptus</i> (<i>Orthograptus</i>) cf. <i>calcaratus</i> Lapworth <i>D. (O.)</i> cf. <i>quadrinucronatus</i> var. <i>spinigerus</i> Lapworth <i>Glossograptus</i> sp. indet. <i>Lasiograptus harknessi</i> (Nich.)		X	X	X		X	X	X
LOCALITY 6 contains: <i>Dicranograptus nicholsoni</i> Hopk. <i>D. furcatus</i> var. <i>minimus</i> Lapworth <i>D.</i> cf. <i>contortus</i> Ruedemann <i>Climacograptus</i> sp. indet. <i>Diplograptus</i> (<i>Orthograptus</i>) cf. <i>calcaratus</i> Lapw.	X	X	X	X		X	X	X

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EXPLANATION OF PLATES.

(Photographs kindly taken by Dr. I. A. Brown.)

PLATE I.

1. *Dicellograptus caduceus* Lapworth, Loc. 9, No. S.1645. × 1.
2. *Dicellograptus* cf. *forchammeri* Geinitz, Loc. 4, No. S.1761. × 2-3.
3. *Dicranograptus nicholsoni* Hopkinson, Loc. 11, No. S.1657. × 2-3.
4. *Dicranograptus nicholsoni* Hopkinson, Loc. 11, coll. by Messrs. Ingall, Joklik and Scott-Orr. × 2.
5. *Dicranograptus* cf. *contortus* Ruedemann, Loc. 11, coll. by Messrs. Ingall, Joklik and Scott-Orr. × 2.

PLATE II.

6. *Diplograptus calcaratus* Lapworth, Loc. 11, No. S.1662. × 2-3.
7. *Diplograptus apiculatus* (Elles and Wood), Loc. 11, No. S.1662. × 4.

8. *Glossograptus hincksii* (Hopkinson), Loc. 11, coll. by Messrs. Ingall, Joklik and Scott-Orr. $\times 2.3$.
 9. *Glyptograptus rostratus* sp. nov., Loc. 12, Sydney University Geological Collection Reg. No. 8289, aspect one-quarter face. $\times 2.3$.
 10. *Glyptograptus rostratus* sp. nov., Loc. 12, No. S.1926, aspect almost bi-profile. $\times 2.3$.
 11. *Climacograptus peltifer* (Lapworth), Loc. 11, coll. by Messrs. Ingall, Joklik and Scott-Orr. $\times 2$.
 12. *Climacograptus peltifer* (Lapworth) with greatly enlarged vesicle, Loc. 11, coll. by Messrs. Packham and Veevers. $\times 2.3$.
 13. *Climacograptus tridentatus* (Lapworth), Loc. 11, No. S.1662. $\times 2.3$.
 14. *Lasiograptus harknessi* (Nicholson), Loc. 11, coll. by Messrs. Ingall, Joklik and Scott-Orr. $\times 4$.
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